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LLNL-TR-438593

Scoping Memo Response

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June 25, 2010

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This work performed under the auspices of the U.S. Department of Energy by Lawrence Livermore National Laboratory under Contract DE-AC52-07NA27344.

TO: Matthew Tisdale, CPUC **DATE: June 18, 2010**

FROM: Jeff Stewart, Noah Goldstein, Alan Lamont, Jim Gansemer, and Evi Dube, LLNL.

Subject: Response to "Assigned Commissioner's Ruling and Scoping Memo, Phase 1", dated May 21, 2010

Matthew – Below are our responses to the questions in the "Scoping Memo" release on May 21, 2010. We hope that our responses help shedding light on the complexity of the EM&V process. We would like the opportunity to follow up with our responses in person, if you are interested.

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What follows is a response to the questions posed in the May 21, 2010 document "Assigned Commissioner's Ruling and Scoping Memo, Phase 1", pertaining to Rulemaking 09-11-014, also referred to as the "Scoping Memo". The questions refer to specific components of the CPUC Energy Efficiency (EE) Evaluation, Measurement, and Verification (EM&V) program, currently in its 2010-2012 cycle. In the Scoping Memo, there was reference to the need to update the policy and methodological framework of EM&V, due to changes in law (AB32), policy (California Long Term Energy Efficiency Strategic Plan), the availability of new data, and challenges to previous EM&V cycles.

Question 1: Objectives of EM&V

1a: Should the objectives of EM&V be changed for 2013 and beyond?

EM&V is a powerful tool as a way of validating the effectiveness of the Energy Efficiency activities of the State. With a valid approach, EM&V can be used to support effective programs and policy, as well as correct ineffective programs. The challenge with EM&V, as it is applied in the 2010-2012 and previous cycles, is that there was little guidance as to how different kinds of measurements and calculations (with their inherent variability) can be used for different purposes. The critical implementation of this gap was the use of vague protocols for identifying energy savings tied to the incentive mechanism for the IOUs.

Given the manifold uses of EM&V, as stated in the question (Policy and Planning support, financial and management audits), the objectives of EM&V should be made more explicit to match each evaluation component. For example, the way in which an IOU Program or a particular installation is evaluated for energy savings is a fundamentally different process from evaluation for financial assessment. Similarly, measuring energy savings for well-tested technology improvements (like refrigerators) is very different from measuring energy savings from cutting-edge innovative technologies that can lead to market transformation. Careful thought needs to given as to what is being measured in EM&V, if it is the appropriate method of measuring what it is intended to do, if the methods are rigorously sufficient, the qualifications of the evaluators, and the methods of assessing the evaluators performance. This is ostensibly an oversight on top of the current EM&V framework, but it would enhance its veracity greatly.

1b: Are the objectives for EM&V sufficient for progress towards the goals of the Strategic Plan and Utilities Contribution?

This question gets at the heart of what kinds of progress the CPUC intends to track. If the CPUC intends to track qualitative assessments (or quantitative assessments with little scientific rigor) of progress towards CPUC goals, the objectives would suffice. If the CPUC intends on developing a process that provides evidence for the ratepayers that the funds are being spent optimally on Energy Efficiency, then EM&V needs to refine its objectives to incorporate rigorous quantitative approaches.

Question 2: Changes to the "California Evaluation Framework" and the "California EE Evaluation Protocol"

2a. Should the Protocols be amended?

The Protocols serve multiple purposes. Primarily they function as a guide and manual for the EM&V Evaluators for their EM&V activities. This makes the Protocols the origin of the EM&V ex-post energy savings, used in turn to evaluate the IOUs. Additionally the Protocols ostensibly serve as a guide to the IOUs as to how their programs will be evaluated, and amended in the future. For example, the Protocols explicitly mention the use of CEC climate thermal zone (CTZ) long-term average weather data when determining Energy Savings. While more precise weather estimates are available, and in fact used by the IOUs in their ex-ante estimates, the IOUs are evaluated by CTZ weather. Both of the intended uses (by the IOUs and the CPUC) should be explicit; the IOUs should be able to understand the methods as to how they will be evaluated before they construct their programs. There are a number of ways in which there are unknowns in place in the Protocols that should be corrected.

First, there is much left to the Evaluator to determine by subjective estimates. Specifically, the "Level of Rigor " for some estimates is to be determined by evaluator, in the following way : " Each rigor level provides a set of allowable methods that offers flexibility for the M&V contractor to propose the most cost effective method considering the conditions prevailing at each sampled site." (p.56) The "level of Rigor" thusly determines how the evaluator measures savings. This indicates that the way the IOU is evaluated is based on some financial constraint unknown at the beginning of the cycle.

Secondly, the use of models and modeling tools is not well documented, validated, nor transparent. While the Protocols state that the modeling and simulation bias should be described, and that ASHRAE-approved models should be used for analysis (like DOE-2), there is no provision for the validation of the implementation of those models. Specifically, an approved model can be used, bias can be described, but there is no mechanism in the Protocols for the validation by third parties or otherwise of specific modeling exercises. In addition, multiple versions of a single model (like DOE-2) can be used over the course of the cycle. This practice introduces a large latitude in model implementation and variability from the results of those implementation such that the IOUs can't determine a priori how they will be evaluated; the explicit use of a specific model (including version number) and a methodology for model use validation would correct that.

Lastly, the Protocols do not present the need for, nor do they describe how, rigorous, scientifically defensible measurements are to be made. By not having a high standard associated with measurements and models, the natural, observable variation of energy savings can come into question, and the methods challenged. While there are descriptions as how to perform Peer Review for the "Emerging Technology" component of EM&V, there is not the same requirement for other methodologies. Standard methodologies, previously accepted by the industry can be used, but it does not mean that the implementation of those methodologies was correct. Additionally Peer Review (or third party review) should not mean evaluation by another EM&V Evaluator or the CPUC Energy Division staff. By making the CPUC EM&V Protocols adhere to a high scientific standard, California will continue to be heralded as a leader in Energy Efficiency.

2b: Should additional methodologies by added?

Additional methodologies of Peer Review, model and measurement validation, and decision-making should be added to make the Protocols explicit for both the IOUs and the EM&V Evaluators. The cost of additional methodologies for both the IOUs and the CPUC Evaluators should be taken into account.

2c: Should the CPUC add methodologies to measure non-energy benefits?

Measuring non-energy benefits has the opportunity to contribute greatly to demonstrate the value of Energy Efficiency beyond just energy. Some of these, like GHG impacts, are closely tied to energy savings, and can (and should) be easily incorporated, given the widespread extant protocols already used for these purposes. Given how the energy savings estimates are fraught with contention, are highly uncertain, and contain variability from multiple causes (weather, location, economics, etc…), the extrapolation to GHG savings should be done first on a provisional basis. The possible

GHG savings will be an estimate, and to address it as a fixed metric will cause other problems, as the IOUs and customers will want to report these and use them for their own purposes.

Other benefits, like economic impact and job creation, are more challenging to calculate. While the Federal Government is currently determining protocols to standardize these calculation (as per the American Recovery and Reinvestment Act (ARRA)), there will be significant challenges in determining the value of these measurements as attributable at the project level. If jobs and economic calculations are to be incorporated, there may be some doubt as to the veracity of the current EM&V evaluators to determine and implement these; they are not necessarily economists. Further examination as to who can determine and how additional metrics can be incorporated is needed.

There is some concern over the additional burden on the EM&V Evaluators as well as the IOUs as to the reporting of additional metrics. The cost to those parties needs to be accounted for, possibly increasing the compensation to both groups, as additional metrics will take more effort by both groups. Additionally, the computerized mechanism to store and distribute additional metrics is nontrivial, and should be examined. A pilot implementation of collecting additional metrics for the 2013-2015 cycle may be a valid approach to their incorporation.

Question 3: Alternative Methodologies to EM&V

The Scoping memo, Question 3 requests comments on a metric proposed in Attachment 1 of D.10-04-029 and comments on the appropriateness of two measurement approaches, one by the NRDC and the other by M. J. Horowitz published in *Energy Efficiency*. The two techniques referred to are methods of measuring energy use over time and drawing some conclusions about the effect of energy efficiency programs.

3a-c. Horowitz paper

Reference: Horowitz, M. J., "Measuring the savings from energy efficiency policies: a step beyond program evaluation", *Energy Efficiency*, published online 14 April 2010

This approach is intended to detect and measure the effect of energy efficiency programs from a time series of data on total energy consumption and other relevant data. It detects it by calibrating a model to a base period of time when there was no energy efficiency program. It uses that model to carry forward an estimate of what the energy use would have been in the absence of an energy efficiency program (the "counterfactual"). This counterfactual trajectory is compared to the actual total energy consumption trajectory. If the energy efficiency program is effective, one would expect to see a divergence between the actual energy use and the counterfactual predicted by the model. The divergence should start at about the date that the energy efficiency program was implemented.

Such a method can be a valuable technique to support an EM&V program. It addresses the question of whether or not our energy consumption is decreasing and, if so, has the energy efficiency program helped.

However, it does not measure efficiency per se. Total energy use might increase even as effective energy conservation measures are put in place. This can occur due to a shift in, say, industrial structure moving to more energy intensive activities, or housing developments growing in hotter, more energy dependent locations. We could see a converse reduction in energy consumption due to a change to low energy intensive industry. Horowitz does argue that these sorts of changes would happen more slowly than the effects of energy efficiency programs.

The usefulness of the Horowitz approach depends on two assumptions: a) the energy efficiency program is introduced at an identifiable date, and b) the energy system demand in the out years follows the same equation as it did in the years before the efficiency program was implemented. These two assumptions suggest that the approach would be useful in the near term, right after implementing a program, but less so in the longer term. As we go out in time after the energy efficiency program has been operating for a number of years, the base years used to calibrate the model become less and less reliable as predictors. Thus, the counterfactual trajectory is less and less meaningful. This would

be compounded over time as the energy efficiency program evolves—we will be less and less sure about which aspect of the efficiency program actually makes a difference.

The approach might be more valuable if the underlying equations were expanded to include industrial structure, housing patterns, etc.

3a-c. NRDC Report

Reference: Sheppard, C., C. Chamberlin, and A. Jacobson, *Exploring strategies for implementing a performance based state efficency program: State energy efficiency metrics—residential sector analyses*, Natural Resources Defense Council and Schatz Energy Research Center, Humboldt State University

This approach calibrates a function to predict the year-to-year changes in per capita (a measure of intensity) energy consumption caused by weather (heating and cooling degree days each year). It applies this function to a multi-year record of energy use in a sector (housing) to obtain a record that is corrected for weather effects. Presumably, the resulting record is the record that would have been produced if the weather had remained constant from year to year.

One can then examine that record to identify periods of multiple years when the per capita consumption declines (statistical tests are used to identify periods that are likely to have true declines, and not just statistical flukes). The authors then conclude that these periods of decline can be attributed to energy efficiency efforts. In the report, it is suggested that states be rewarded when their per capita consumption declines. However, that aspect of the report is not essential for the CPUC's purpose.

The adjustment of the record for weather effects does tend to smooth out the record. If one were to use this approach for measuring changes in per capita energy consumption, smoothing out these deviations would result in an estimate with a smaller variance. Presumably over a long period of record (perhaps 10 year or more) the smoothed and un-smoothed record would give pretty much the same answer for average rate of change in energy consumption.

The results shown in the report illustrate the problems inherent in any time series method. The data for states show periods of increase and periods of decrease. If we interpret the periods of decrease as signaling when the energy efficiency policies were in effect, we are left with the symmetric interpretation that the periods of increase signal periods when the policies must have been absent. This is, of course, not true and is not what the authors intend, but it is the logical conclusion. The point is best illustrated by the data from Nevada. There are several periods of decrease and the statistical methods used by the authors flag these periods as statistical significant (and thus probably real), implying that there was an effective energy efficiency program in those years. But, overall (20 years of record) there is no trend for Nevada. Thus, the periods of decrease probably represent something other than energy efficiency. Conversely, the trend for California is clearly downward, dropping about 15% in 20 years. But, there are only 11 years out of the 20 that indicate that California's energy efficiency program is working. Thus, in about half the years we would conclude that the energy efficiency program is either not effective or absent.

Overall the method suffers by not accounting for economic variations (prices, economic activity, etc) that will surely affect energy use, or structural changes. Omitting these data limits its effectiveness in detecting the effects of the energy efficiency programs.

3a-c. Proposed tasks for Project Number 12

Attachment 1 of D.10-04-029 states that the there will be a study to design and implement an EM&V approach to assess energy consumption that includes the following:

> "a. Defining energy intensity indicators for the different end−use sectors;

b. Identifying behavioral and structural factors that can affect energy intensity but not related to energy efficiency improvements.

c. Identifying the effects of the IOUs programs in the reduction of energy consumption for a given end−use sector; "

These are all essential elements of an assessment program. However, the description presented here is a bit sparse for defining a metric. Below are some comments that might be helpful in assessing this approach.

Measuring energy requires that we first define what we are trying to measure. The discussion in the Attachment 1 of D.10-04-029 refers to "energy intensity" and "energy efficiency" as if they were different issues. Energy intensity measures energy efficiency. It is the amount of energy used per unit of activity (energy per household, energy per GDP, etc.). The distinction is important here since one of the proposed methods (Horowitz) measures total energy use, not efficiency, while the other (NRDC) does measure energy efficiency (as energy per capita). Total energy consumption determined by energy efficiency and the level of activities. Total consumption might increase even while efficiency is increasing, if the levels of activity are increasing rapidly.

Methods in the literature try to measure "energy efficiency". Some measure this as a change in energy intensity and some measure it as a change in total energy used. It seems that it is best to measure it as energy intensity since that is what it is. However, it is inevitable that the legislature and the public will want to know if we are actually reducing energy use. Consequently, some measure of total energy use will be required.

The energy efficiency programs that affect energy equipment are targeted to affect energy intensity at the locations where they are installed. The benefit of the efficiency program is determined by a) the change in energy intensity per installation, and b) the number of installations. If we are to measure the effectiveness of the energy efficiency programs, we should be measuring these elements. The three issues described in Attachment 1 seem to be targeted at measuring them. The change in total energy is determined by these elements along with factors such as structural changes, prices, income, etc. The EM&V program probably will be required to at least comment on the effects of these other factors, but they are not the core of the energy efficiency activities.

Question 4: Other approaches to EM&V

California would benefit most for quantitatively rigorous methods that attempt to model, analyze, and then estimate energy savings, cost-effectiveness, and attribution of EE programs. Given the importance of EE to the loading order, and the high degree of scrutiny the EE receives, in part due to the incentive mechanisms for the IOUs, being able to present numerical estimates that account for uncertainties greatly contributes to the validity of using EE for State-wide load reduction. Smart Meter initiatives hold great promise and will be most valuable when coupled with complete data capturing methodologies. In short – the metrics associated with EE are just estimates, and with Smart Meters and Appliances in place, the uncertainty of those estimates has the potential to both be characterized and shrink.

Question 5: Leveraging Technological Innovations

There are a number of technological Innovations that can be incorporated into the EM&V process. These include Advanced Metering Infrastructure (AMI) , such as Smart Meters and Smart Appliances, as well as novel user interfaces, such as Building Energy Dashboards. These technologies can provide greater precision when collecting data at the building or sub-meter level, both in terms of temporal frequency, energy use, and outlier events, all of which have been mentioned as conflicts in the recent (2006-2008) EM&V cycle. New technologies can also reduce the cost of building and appliance monitoring, through remote data collection techniques (e.g. cellular phone network data collection, drive-by data collection, etc…). Advanced metering at the appliance level, either by large-scale installations (e.g. HVAC systems) or for domestic use (e.g. refrigerators) will be a very powerful data collection tool for the long-term

transformation of the energy system, through Demand-Side management and customer awareness. Links with industry for EM&V would be timely as the AMI industry is rapidly evolving.

It would be valuable to explore the use of building energy meters and interfaces (e.g. Opower, Building Dashboards, Hohm, Google PowerMeter, etc..) as these may lead to changes in customer energy use. These devices have been shown to help reduce energy use to some extent by providing dynamic and contextual information in real time. However, building energy interface do provide a challenge in the EM&V context, in the form of the "attribution issue." If an IOU aids a customer to install a new technology as well as building energy interface, it will be challenging to determine what the net cause of energy savings would be; this is a ripe area of research as well.

Any new technology would have to be rigorously tested before formal acceptance into the EM&V process. Due to the apparent issues PG&E is having with their Smart Meter program, the use of AMI will have to performed, at first, in concert with traditional methods, as to prevent challenges from stakeholders.

Question 6: Changes to be implemented for the 2013-2015 cycle

We foresee similar acrimony and challenges to the 2010-2012 process as the previous cycle due to the continued use of a system that lends itself to conflict, as described in the LLNL "White Paper". These factors include:

1) The Mid-cycle changing to the methods and rules of EM&V and Energy savings estimates
2) The opaque process of changing the EM&V process
3) The significant workload and incompatible responsibilities of the administrators of the EM&V Process (CPUC Energy Division)
4) The lack of a rigorous, scientific approach to measurement and validation

While some steps have been taken to address these issues, like a formal process of dispute resolution, the structure and rigor of the EM&V system for the 2010-2012 cycle will remain mostly the same. We suggest a more in-depth revision of the approach to EM&V for the 2013-2015 cycle.

Question 7: EM&V practices to include needs and activities of other California Agencies (CEC, Municipal Utilities, CARB, etc…)

7a: Existing metrics accounting for GHG reductions

The current metrics have the potential to account for GHG reductions; however, as mentioned above, the significant variability and uncertainty associated with the estimation of Energy Savings that makes the associated GHG savings also of dubious quality. As EE credits may be used as a proxy for Carbon credits, accurately representing the value of potential savings will be scrutinized nationally, and world-wide.

One helpful set of metrics that can be tracked with estimated energy savings associated with technology deployment is emissions-based GHG savings. This metric is primarily associated with refrigeration and HVAC upgrades; the gases used in these applications tend to leak and have very high Carbon equivalencies, and removing them or reducing their usage is a large benefit. There are currently a number of State programs, as well as credits associated with high Global Warming Potential gasses in green building rating systems, like the US Green Building Council's LEED program.

Also of note would be to ascertain who can take credit for the GHG savings, the IOU or the customer. There is a growing monetization of GHG credits, and who "owns" them will have to be clear; without tracking provenance, the contention can thwart the intention and integrity of the program. Other State agencies are working on this issue; close coordination would be advisable.

7b: Do existing metrics meet the CEC's needs in load forecasting?

The current metrics have the potential to help in load forecasting, but as mentioned above, the uncertainty and variability of these estimates makes their utility for load forecasting challenging. More research and case studies are needed to connect the energy savings estimates with load forecasting. This will considerable be aided by smart appliances and smart meters, as well as higher resolution weather and economic data. This is a wide-open research area.

In terms of the use of the EE metrics for peak load reductions, we feel the current program, including the creation of EE State-wide Goals, has done a poor job of relating these two topics. The method originating in the "Secret Surplus" study, marginally recently revised, use coarse methods of relating peak load savings with individual technology changes. Given the importance of reducing peak load during key periods, this component of the Goals, as well as approach to IOU program creation, is in need of reexamination and revision.

To better assess future demand, econometric analyses, used in concert with Advanced Metering initiatives will considerable aid the development of better estimates of future loads (see response to Question 3). These activities and investigations would greatly benefit from close coordination between the CEC, who creates annual forecasts of energy demand, CASIO, who helps forecast the load on the system, and product manufactures, who have insight how their products are used.

7c: Steps for better inter-agency coordination

Given the importance of Energy Efficiency in the State, and the impact of EE on GHG savings, better coordination and communication between various State agencies would be welcome. This could occur in a variety of formats, both open to the public and closed to the public. These include:

a) Annual or quarterly briefings from relevant agencies (CPUC, CEC, ARB, and others) on major developments, findings, and issues in EE and GHG projects.
b) The presentation of sample EE projects by the IOUs in a public setting for education of agencies and the public at large
c) An inter-agency working group on how to refine methods of EE implementation, savings estimation, and GHG calculation. The discussion of what does and doesn't work will help make agency-based projects more efficient.
d) A common method of sharing and storing data for Energy Systems. Well-documented, highly resolved data is the key towards understanding the implications of policy on the Energy System, and then to promote EE and GHG reductions. This would have to entail creating a secure, collaborative web portal for data cataloging, analysis, dissemination and visualization.